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SPECIFICATION

ANTISTATIC AGENT AND RESIN COMPOSITION AND FORMED PRODUCT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an antistatic agent and an antistatic resin composition and an antistatic resin formed product.

2. Description of the Related Art

Plastics have excellent properties such as easy processability, high ^{productivity} ~~pro-~~ ductivity, light weight and relative low procuring cost, so they are used for the parts and structural materials for ^{automobile} ~~auto-~~ mobile, autobicycle, scooter, television, radio, audio equipment, washing machine, rice cooker, personal computer, portable telephone, game machinery, building ^{materials} ~~mate-~~ rials, office supplies, stationery, toys, sports goods, sports equipment, ^{agricultural} ~~agricul-~~ tural tools, marine tools, sheet and film.

They are usually prepared by plastic ^{molding} ~~mo-~~ lding, blow molding, compression molding, transfer molding, rotating molding, slush molding, inflation tubular film process, and extrusion molding.

Plastic resins, especially polyethylene or polypropylene which ^{have} ~~has~~ no polar ^{electrical} ~~electr-~~ ical insulating resistant, resulting to ^{in the easy generation of} ~~generate~~ easily the static electricity

Similar
when ~~same~~ or different plastic resins are rubbed, consequently they take an electrical charge.

And just ~~then~~ ^{when formed,} the plastic resin ~~formed~~ ^{products} take an electrical charge, ~~so that~~ ^{resulting} they adsorb the dust in surrounding, ~~result-~~ ^{ing} not only to make their appearance worse but also to give uncomfortable feeling when ~~worker~~ ^{workers} or ~~user~~ ^{users} touch them.

Electrical charging sometimes becomes the cause of ignition and occasionally generates the ~~trouble~~ ^{troubles} of production ~~stoppage~~ ^{products} owing to the plastic resin formed ~~product's~~ ^{and} surrounding ^{to} the processing machine at the production step.

Also, electrical charging of the ~~plastic~~ ^{plastic} resin formed product gives ~~a bad influence~~ ^{a bad influence} when they are printed, painted or corona discharged.

As ~~the~~ ^a preventing means for electrical discharging, there has been ~~practised~~ ^{practiced} the methods such as coating ~~the~~ ^a surface active agent on the surface of the ~~plastic~~ ^{plastic} mold or plastic film; mixing ~~the~~ ^a surface active agent by kneading into plastics; immersing the plastic product into ~~the~~ ^a surface active agent solution; or spraying ~~the~~ ^a surface active agent ~~on~~ ^{on} the plastic product, ~~to be adhered.~~

There are many kinds of ~~the~~ ^{agents} surface active agent such as anionic, nonionic, cationic and amphoteric type.

Anionic type is ~~inferior~~ ^{surface active agents are} at ~~compatibility~~ ^{compatibility} with plastics and ~~makes~~ ^{make} the ~~plastic~~ ^{plastics} product's transparency worse.

Nonionic type has better compatibility

[↑] surface active agents have

type surface active agents

with plastic than ~~that of~~ anionic type, however nonionic ~~types~~ ^{type} gradually ~~loses~~ ^{lose} ~~the~~ antistatic effect ~~according to~~ ^{with} the passing of time and nonionic ~~types~~ ^{types} bleed out from inside of the plastic to the surface of it to cause whitening of the surface, resulting ~~to~~ worse the product appearance.

Cationic and amphoteric type ~~is inferior~~ ^{surface active agents are inferior} at heat resistance ~~to cause~~ ^{causing} ~~colouring~~ ^{causing colouring} notwithstanding ~~its~~ ^{their} good antistatic effect.

The above mentioned problems of each surface active agent are expected to improve.

An antistatic agent containing ~~the~~ ^a organic boron compound is disclosed in the Japanese Laid-open Patent 4-252287, the organic boron compound which is ~~obtained~~ ^{obtained} ~~ained~~ by reacting ^{an} alcohol residual group containing compound having two adjacent hydroxyl ~~groups~~ ^{groups} with boric acid or borate ester.

The organic boron compound ~~is pointed~~ ^{overcomes} ~~its defect of~~ short durable terms of antistatic effect and whitening ~~of the~~ ^{of surface} ~~face~~ of plastic molded product by ~~bleeding~~ ^{bleeding} of the organic boron compound.

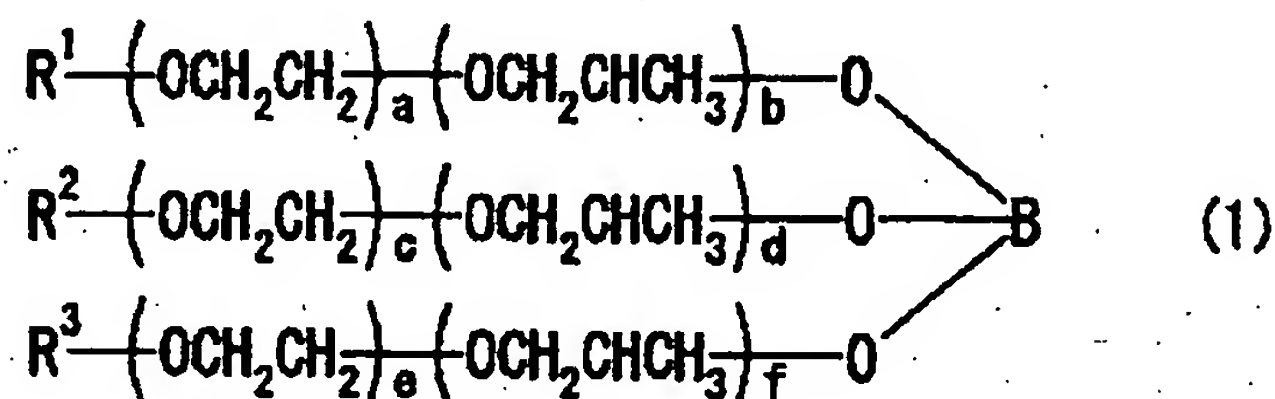
SUMMARY OF THE INVENTION

As a result of diligent investigation by the present invention under such ^{situation} ~~situation~~ ^{which contains} ~~containing~~ ^{containing} an antistatic agent ~~characterized by~~ ^{containing} ~~aining~~ a borate ester of polyoxyalkylene,

and an antistatic plastic resin, ^{composition} ~~composition~~ and an antistatic plastic resin formed product.

DETAILED DESCRIPTION OF THE INVENTION

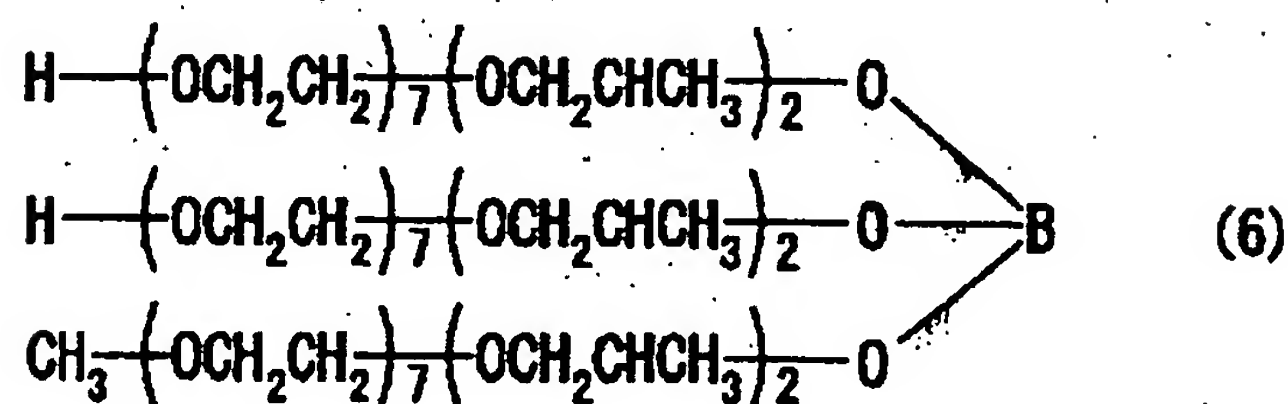
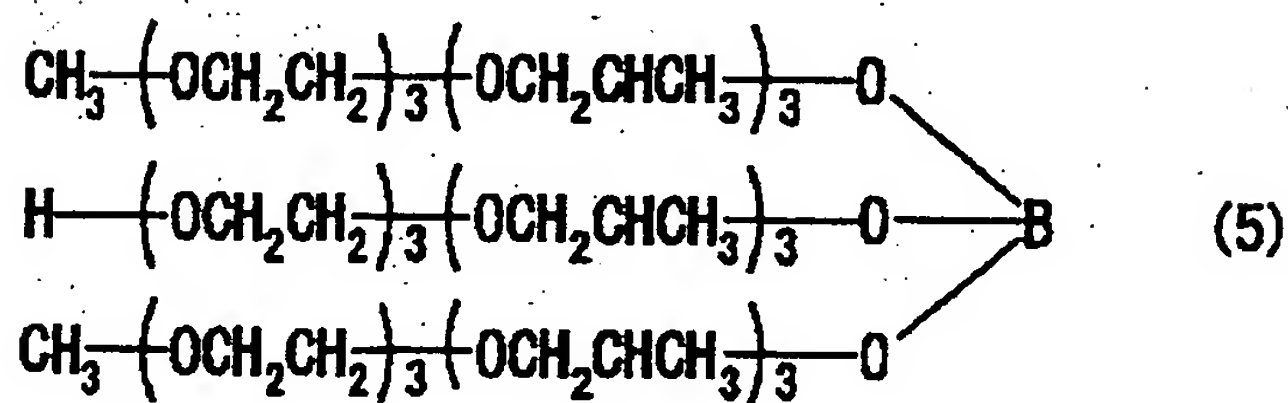
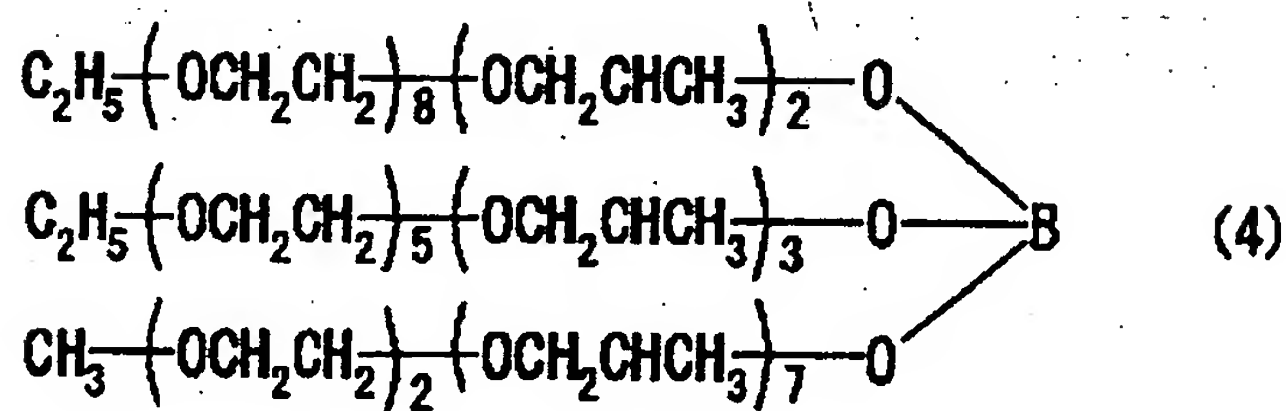
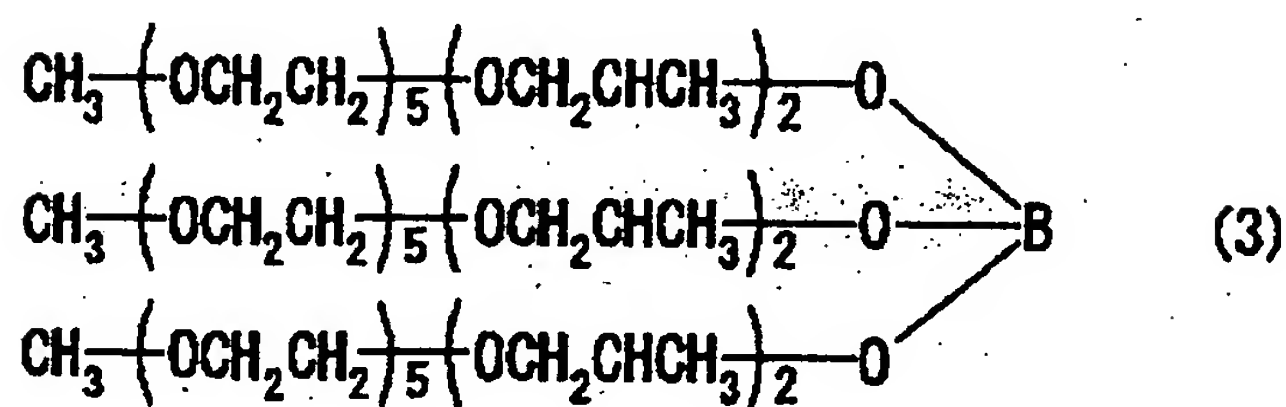
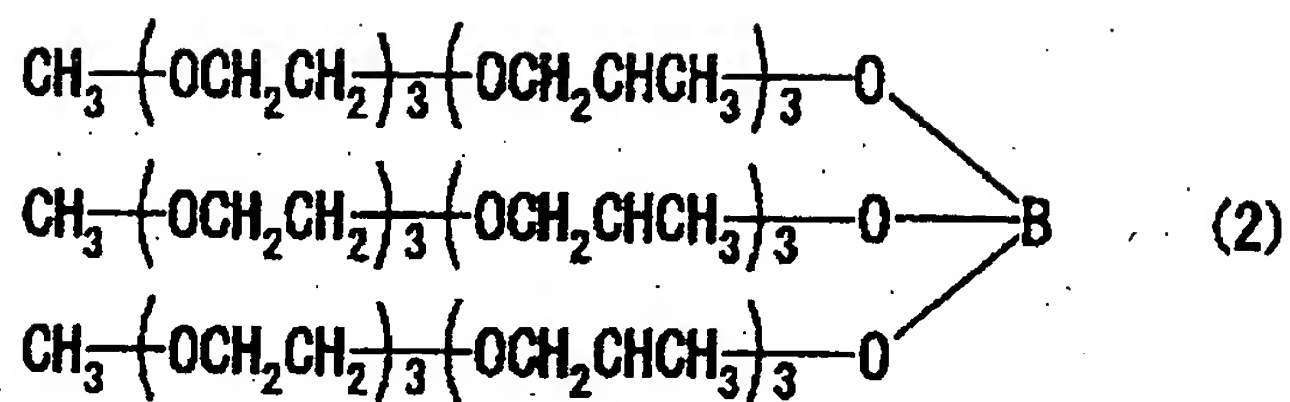
A borate ester of polyoxyalkylene ^{chemical} used for the present invention is a ~~chemical~~ ^{following} compound expressed by the ~~following~~ ^{following} general formula (1).

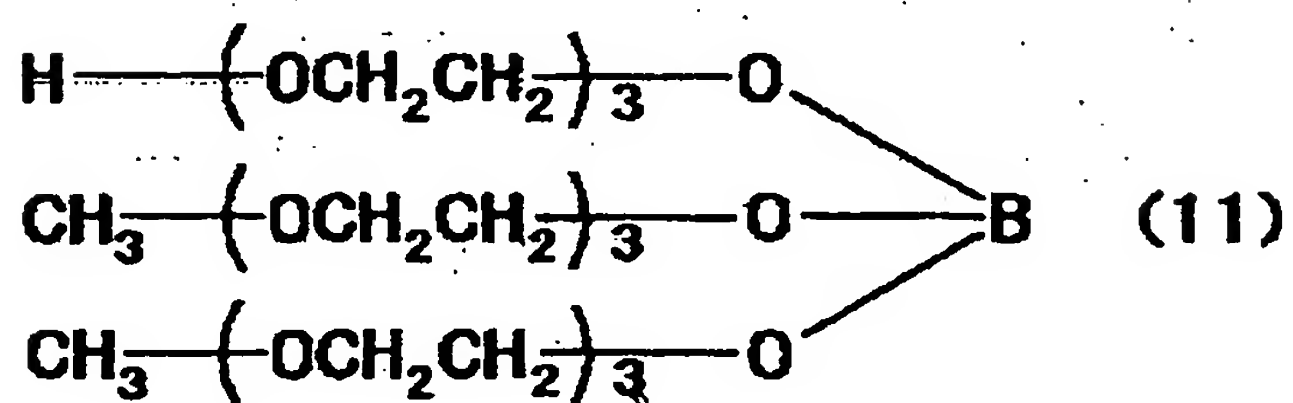
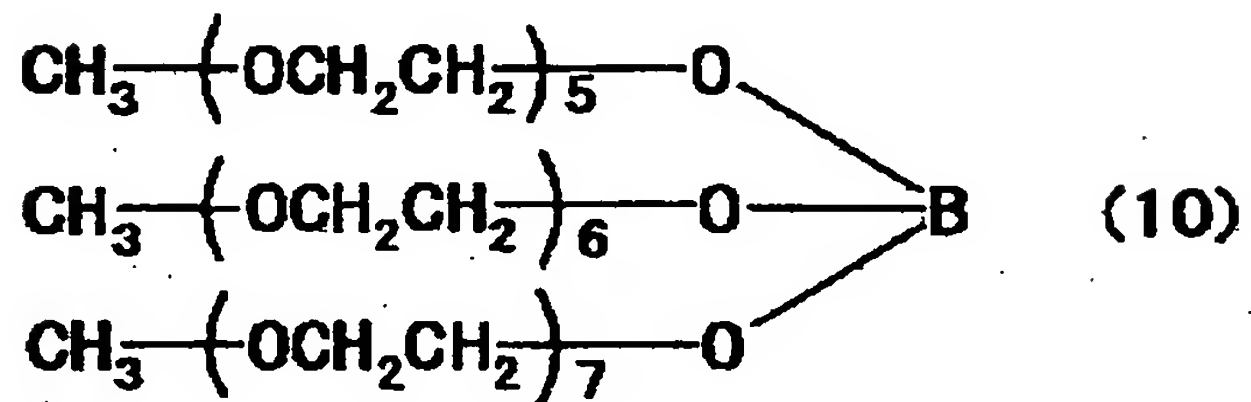
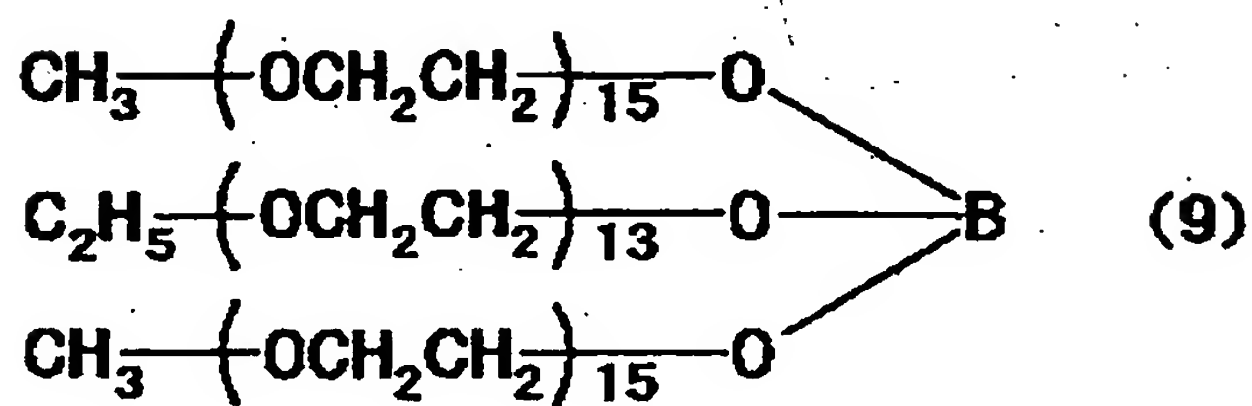
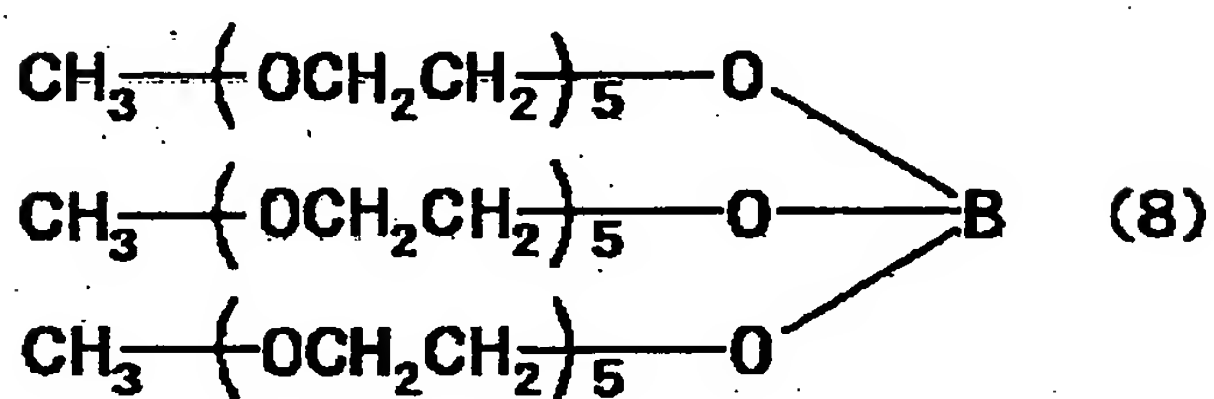
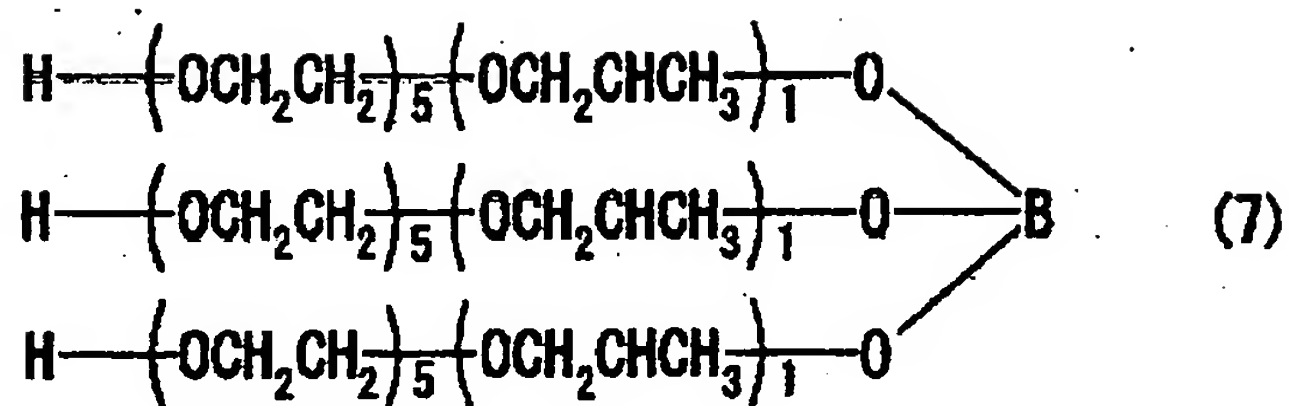


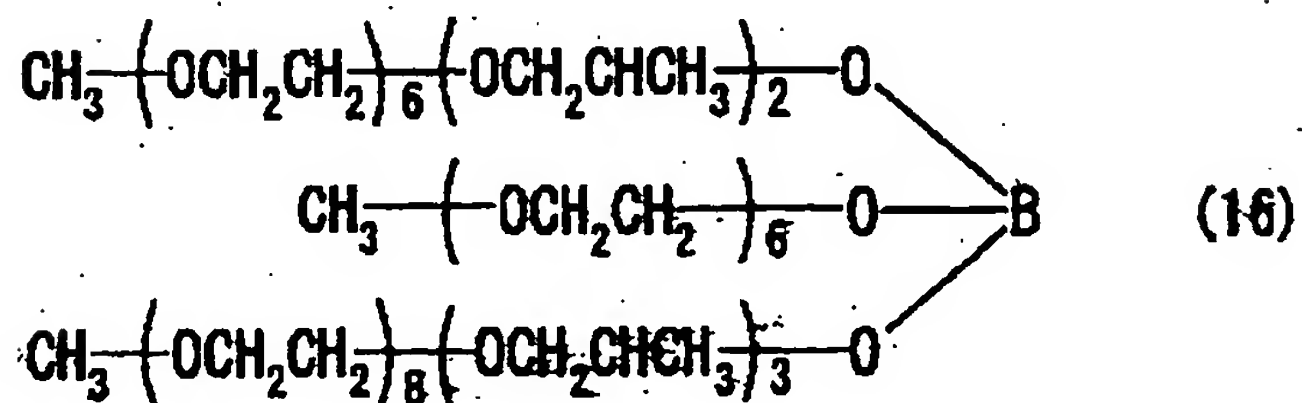
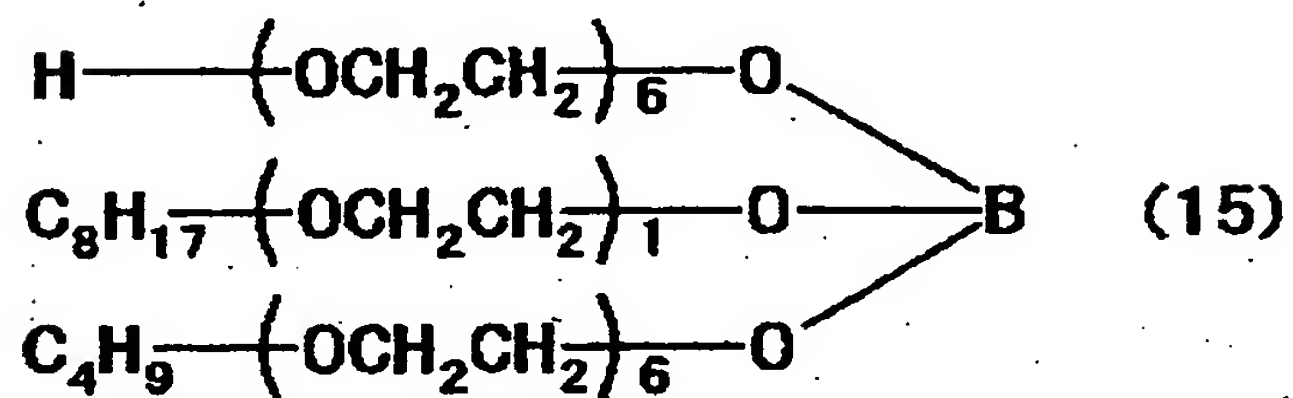
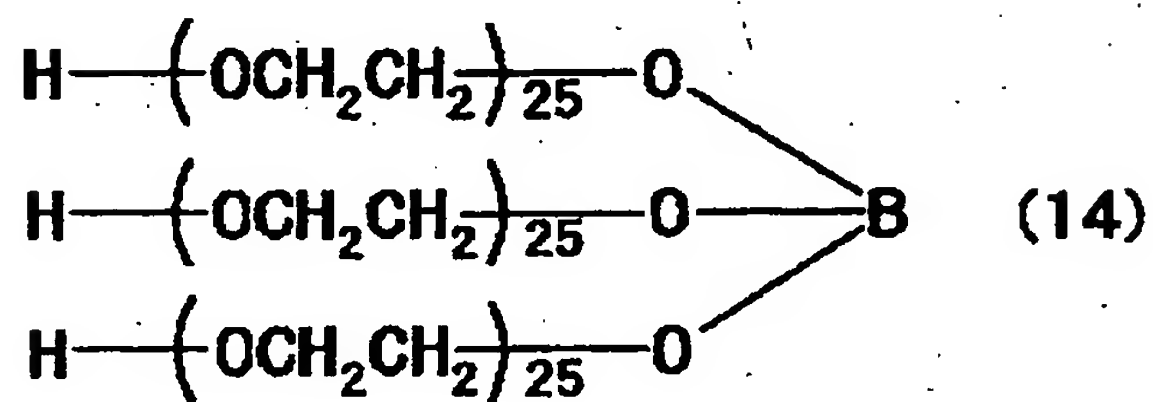
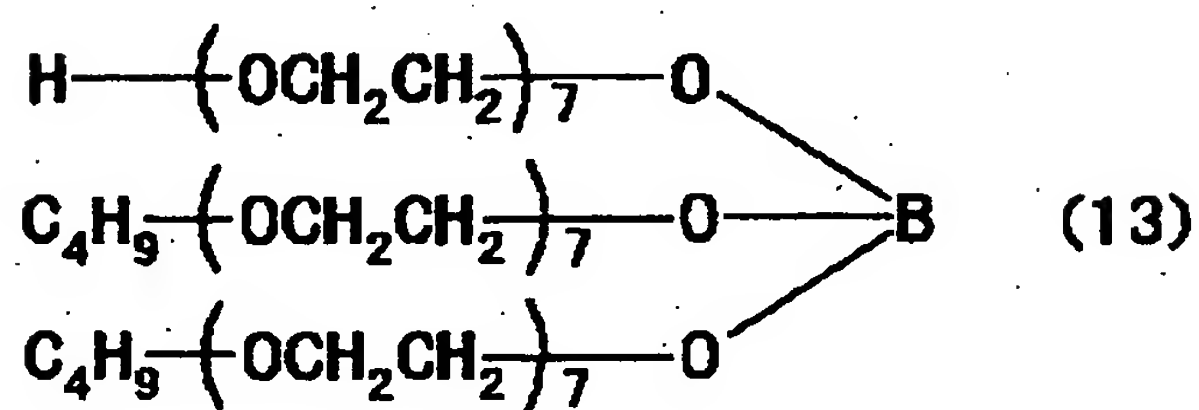
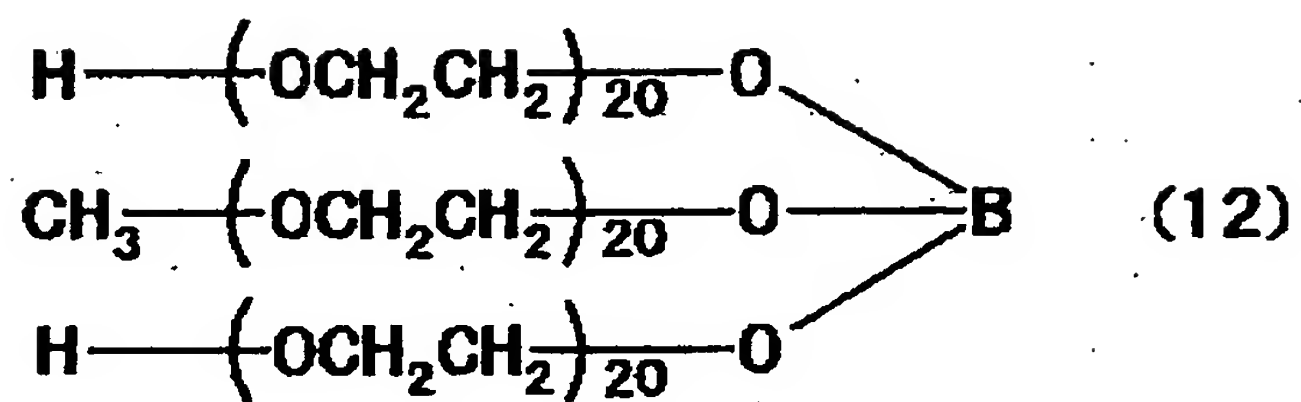
wherein R^1 , R^2 and R^3 are independently selected from ^{the} group consisting of ^{hydrogen} ~~hydrogen~~ and hydrocarbon ^{groups} ~~group~~, a , b , c , d , e and f are positive integers independently ^{selected} from 0 to 30 whose sum is from 6 to 80.

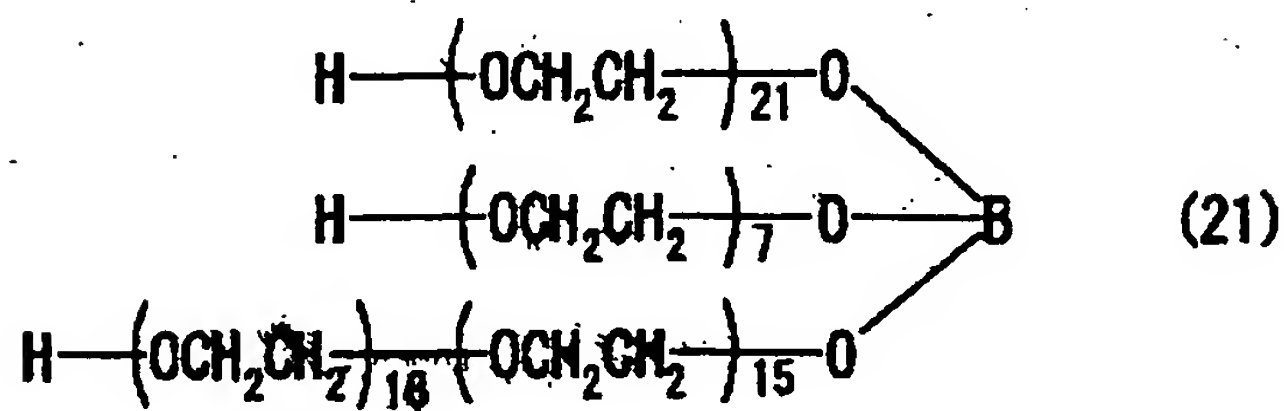
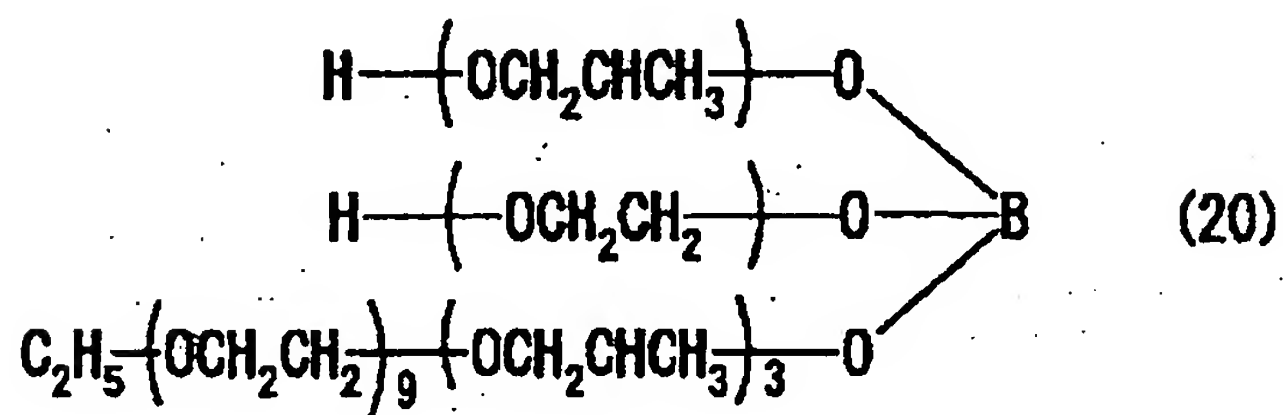
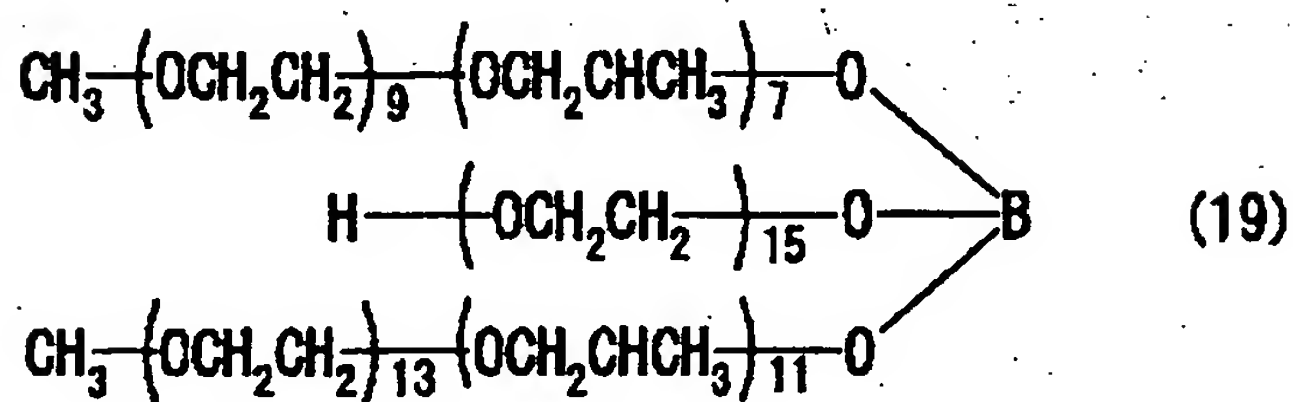
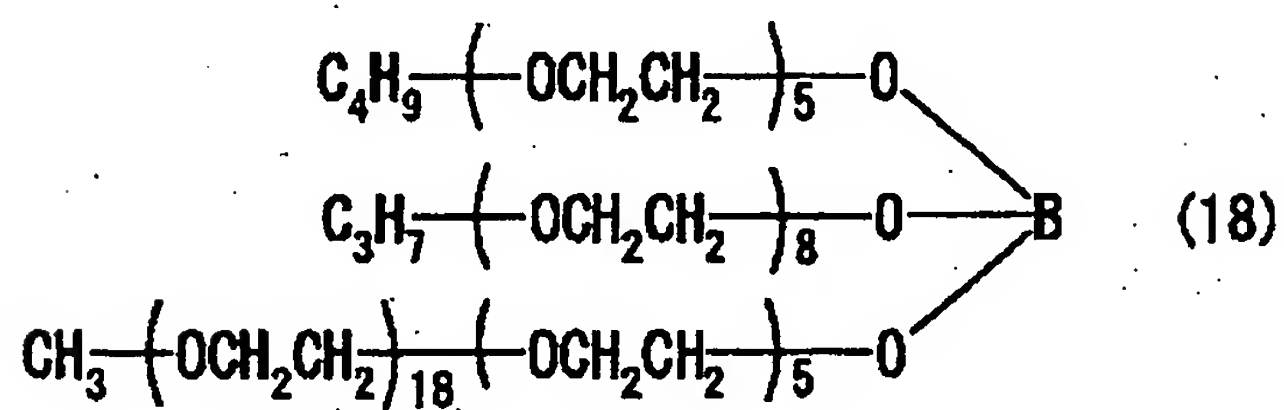
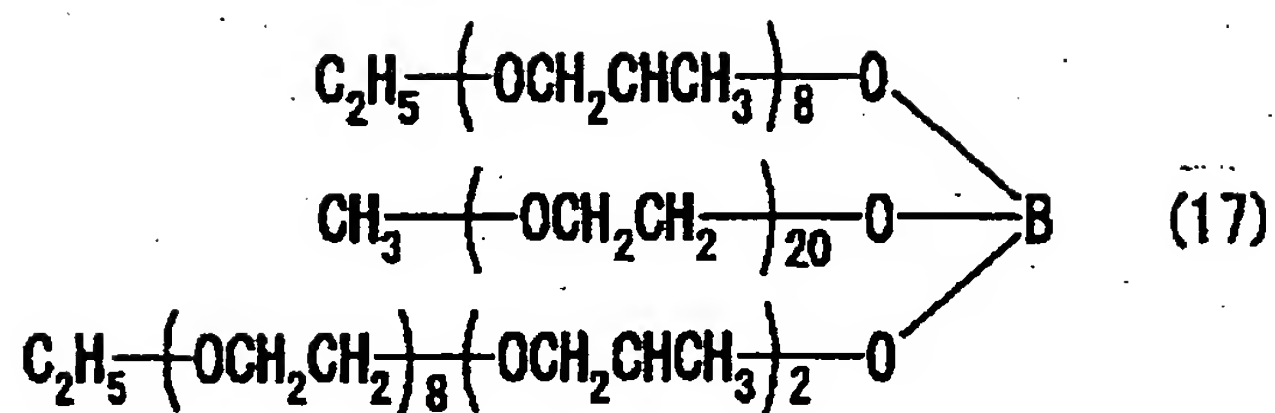
^{Examples} ~~Example~~ of the hydrocarbon group ^{groups} are alkyl ~~group~~ ^{groups} such as methyl, ethyl, ^{propyl} ~~propyl~~, isopropyl, ^{butyl} ~~butyl~~, ^{pentyl} ~~pentyl~~, hexyl, ^{octyl} ~~octyl~~, nonyl, decyl, dodecyl, hexadecyl, octadecyl and docosyl groups and phenyl, tolyl and cyclohexyl ~~group~~ ^{groups}.

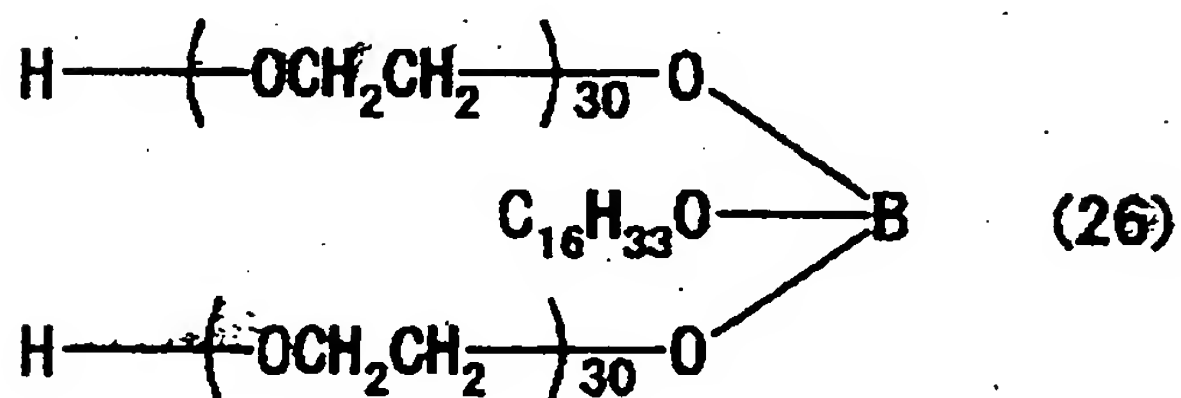
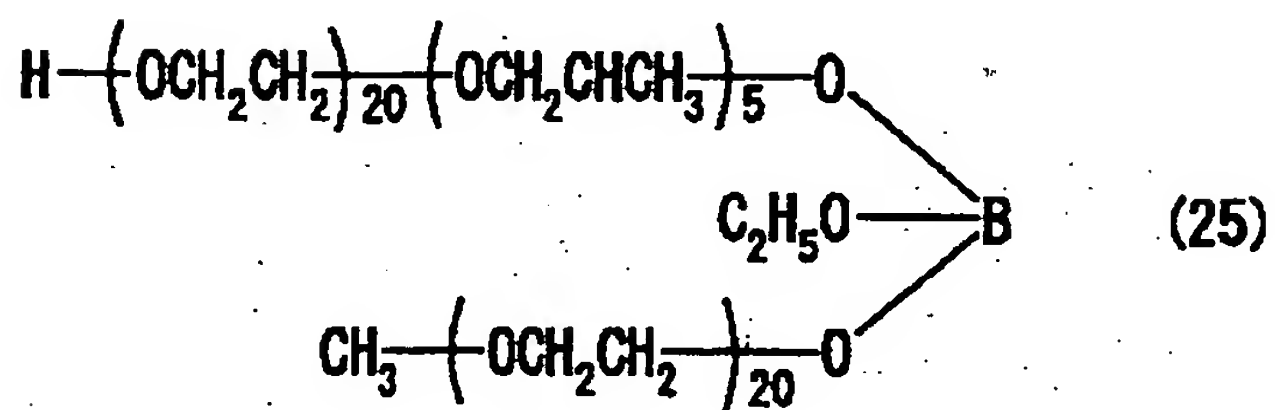
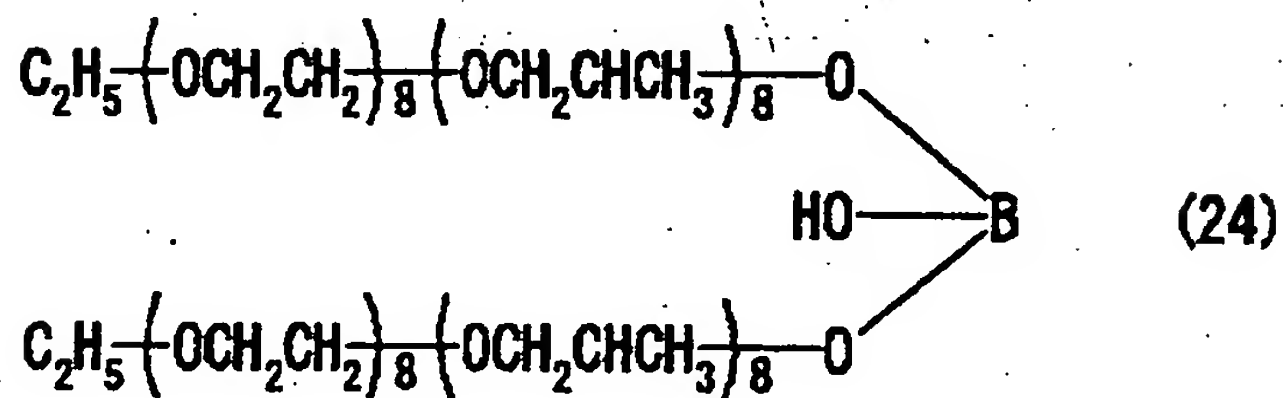
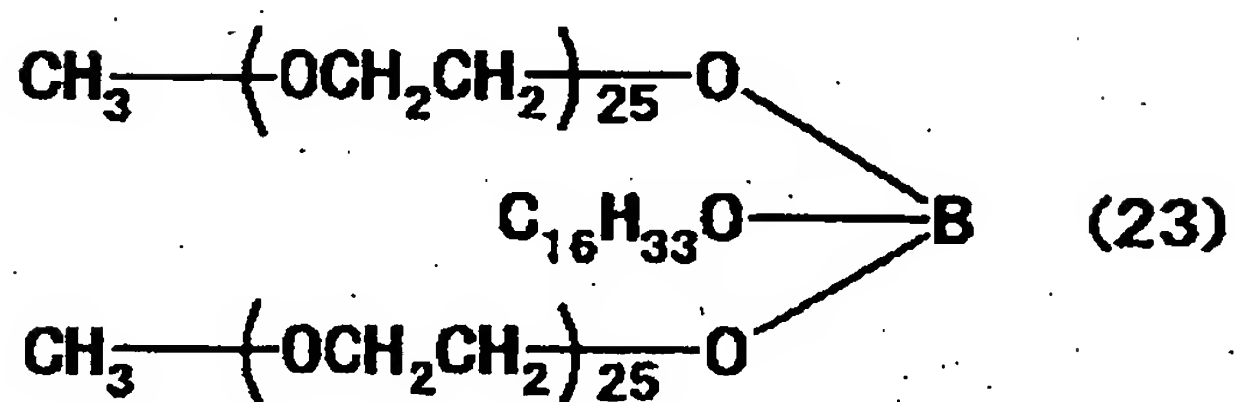
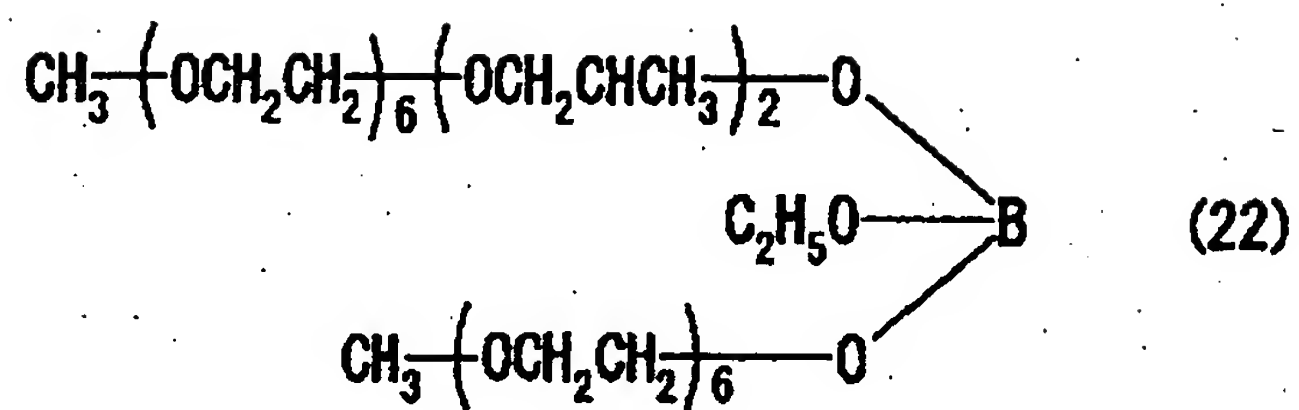
Illustrative of the borate ^{ester} ~~ester~~ of polyoxyalkylene are the chemical ^{compounds} ~~compounds~~ ^{and} expressed by the following chemical formula from (2) to (27).

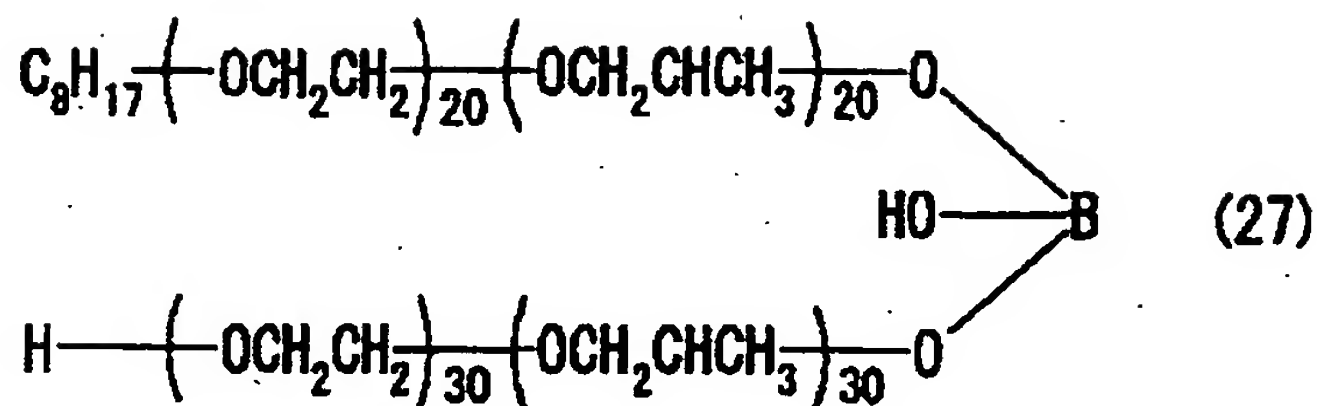












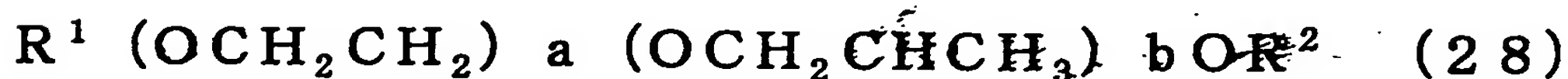
Production method for borate esters of polyoxyalkylene used for ~~the~~ ^{the} present ~~in-~~ ^{invention} ~~vention~~ ^{methods,} are not limited to specific ~~met-~~ ^{methods,} ~~hod,~~ ^{however} but following method is preferable.

The borate esters of polyoxyalkylene are produced by ~~esterification~~ ^{esterification} ~~dehydrat-~~ ^{dehydration} ~~ion~~ or ester-exchange reaction by ~~conta-~~ ^{contacting} ~~cting~~ ^{the} polyoxyalkylene expressed by the chemical formula (28) with boric acid or borate esters of lower ~~alcohol~~ ^{alcohols} such as methyl alcohol or ethyl alcohol.

It is ~~preferable~~ ^{preferable} that reaction ~~is~~ ^{be carried} ~~car-~~ ~~ried~~ out by using 1 mol of boric acid or borate esters of lower alcohol with from 3 to 3.5 moles of polyoxyalkylene ~~expre-~~ ^{expressed} ~~ssed~~ by the chemical ~~formula~~ ^{formula} (28).

If the mole ratio is less than 3, it is not ~~preferable~~ ^{preferable} because undesirable byproducts of borate esters having two or three boron atoms are generated.

~~The other~~ ^{Other} byproducts or unreacted polyoxalkylene may ~~be~~ ^{remain} ~~remained~~ in the borate esters ~~unless~~ ^{so long as} they do not hinder the purging effect of the resin ~~composi-~~ ^{composition} ~~tion~~ of the present invention.



wherein R^1 and R^2 are independently ^{selected} ~~selected~~ from ^{the} ~~a~~ group consisting of hydrogen and hydrocarbon group, a and b are ^{independently} ~~independently~~ ^{selected} ~~selected~~ from 0 to 30.

^{Examples} ~~Example~~ of ~~the~~ hydrocarbon ^{groups} ~~group~~ are ^{propyl,} ~~prop-~~ alkyl group such as methyl, ethyl, ~~prop-~~ ^{butyl} ~~yl,~~ isopropyl, ~~butyl~~, pentyl, hexyl, octyl, nonyl, decyl, dodecyl, hexadecyl, octadecyl and docosyl groups and phenyl, tolyl and cyclohexyl group. ^{expressed}

^{Examples} ~~Example~~ of the polyoxyalkylene ~~expressed~~ ^{expressed} by the chemical formula (28) are as follows.

diethylene glycol monomethyl ether,
diethylene glycol monoethyl ether,
diethylene glycol monoisopropyl ether,
diethylene glycol monobutyl ether,
diethylene glycol monooctyl ether,
diethylene glycol monodecyl ether,
diethylene glycol monohexadecyl ether,
diethylene glycol monooctadecyl ether,

triethylene glycol monomethyl ether,
triethylene glycol monoethyl ether,
triethylene glycol monoisopropyl ether,
triethylene glycol monobutyl ether,
triethylene glycol monobutyl ether,
triethylene glycol monooctyl ether,
triethylene glycol monodecyl ether,
triethylene glycol monohexadecyl ether,
triethylene glycol monooctadecyl ether,

tetraethylene glycol monomethyl ether,
tetraethylene glycol monoethyl ether,
tetraethylene glycol monoisopropyl ether,
tetraethylene glycol monobutyl ether,

tetraethylene glycol monoethyl ether,
tetraethylene glycol monodecyl ether,
tetraethylene glycol monohexadecyl ether,
tetraethylene glycol monooctadecyl ether,

polyethylene glycol monomethyl ether,
polyethylene glycol monoethyl ether,
polyethylene glycol monoisopropyl ether,
polyethylene glycol monobutyl ether,
polyethylene glycol monoethyl ether,
polyethylene glycol monodecyl ether,
polyethylene glycol monohexadecyl ether,
polyethylene glycol monooctadecyl ether,

dipropylene glycol monomethyl ether,
dipropylene glycol monoethyl ether,
dipropylene glycol monoisopropyl ether,
dipropylene glycol monobutyl ether,
dipropylene glycol monoethyl ether,
dipropylene glycol monodecyl ether,
dipropylene glycol monohexadecyl ether,
dipropylene glycol monooctadecyl ether,

tripropylene glycol monomethyl ether,
tripropylene glycol monoethyl ether,
tripropylene glycol monoisopropyl ether,
tripropylene glycol monobutyl ether,
tripropylene glycol monoethyl ether,
tripropylene glycol monodecyl ether,
tripropylene glycol monohexadecyl ether,
tripropylene glycol monooctadecyl ether,

tetrapropylene glycol monomethyl ether,
tetrapropylene glycol monoethyl ether,
tetrapropylene glycol monoisopropyl
ether,

tetrapropylene glycol monobuthyl ether,
tetrapropylene glycol monoocthyl ether,
tetrapropylene glycol monodecyl ether,
tetrapropylene glycol monohexadecyl
ether,
tetrapropylene glycol monooctadecyl
ether,

polypropylene glycol monomethyl ether,
polypropylene glycol monoethyl ether,
polypropylene glycol monoisopropyl ether,
polypropylene glycol monobuthyl ether,
polypropylene glycol monoocthyl ether,
polypropylene glycol monodecyl ether,
polypropylene glycol monohexadecyl ether,
polypropylene glycol monooctadecyl ether,

diethyleneglycol tripropyleneglycol
monomethyl ether,
tetraethyleneglycol dipropyleneglycol
monomethyl ~~meth~~er, *ether*
tetraethyleneglycol tripropyleneglycol
monomethyl ether,
tetraethyleneglycol tetrapropyleneglycol
monomethyl ether,
pentaethyleneglycol dipropyleneglycol
monomethyl ether,
pentaethyleneglycol tripropyleneglycol
monomethyl ether,
diethyleneglycol tetrapropyleneglycol
monomethyl ether,

hexaethyleneglycol dipropyleneglycol
monomethyl ether,
hexaethyleneglycol dipropyleneglycol
monomethyl ~~meth~~er,
ether

hexaethyleneglycol tripropyleneglycol
monomethyl ether,
hexaethyleneglycol tetrapropyleneglycol
monomethyl ether,
hexaethyleneglycol pentapropyleneglycol
monomethyl ether,
hexaethyleneglycol hexapropyleneglycol
monomethyl ether,

heptaethyleneglycol dipropyleneglycol
monomethyl ether,
heptaethyleneglycol dipropyleneglycol
monomethyl ether,
heptaethyleneglycol tripropyleneglycol
monomethyl ether,
heptaethyleneglycol tetrapropyleneglycol
monomethyl ether,
heptaethyleneglycol pentapropyleneglycol
monomethyl ether,
heptaethyleneglycol hexapropyleneglycol
monomethyl ether,
heptaethyleneglycol *heptapropyleneglycol*
~~heptapropyleneglycol~~
~~or~~ monomethyl ether,

octaethyleneglycol dipropyleneglycol
monomethyl ether,
octaethyleneglycol tripropyleneglycol
monomethyl ~~ether~~, *ether*
octaethyleneglycol tetrapropyleneglycol
monomethyl ether,
octaethyleneglycol pentapropyleneglycol
monomethyl ether,
octaethyleneglycol hexapropyleneglycol
monomethyl ether,
octaethyleneglycol heptapropyleneglycol
monomethyl ether,

polyethyleneglycol polypropyleneglycol
monomethyl ether,

triethylene glycol ,
tetraethylene glycol ,
pentaethylene glycol ,
hexaethylene glycol ,
heptaethylene glycol ,
octaethylene glycol ,
decaethylene glycol ,
tridecaethylene glycol ,
hexadecaethylene glycol ,
eicosaethylene glycol ,
pentacosaeethylene glycol ,
triacosaethylene glycol ,

tripropylene glycol ,
tetpropylene glycol ,
pentapropylene glycol ,
hexapropylene glycol ,
heptapropylene glycol ,
octapropylene glycol ,
decapropylene glycol ,
tridecapropylene glycol ,
hexadecapropylene glycol ,
eicosapropylene glycol ,
pentacosapropylene glycol ,
tricosapropylene glycol ,

triethylene glycol tripropylene glycol,
tetraethylene glycol dipropylene glycol,
tetraethylene glycol tripropylene glycol,
tetraethylene glycol tetrapropylene
glycol,
pentaethylene glycol dipropylene glycol,
pentaethylene glycol tripropylene glycol,

hexaethylene glycol dipropylene glycol,
hexaethylene glycol tripropylene glycol,
hexaethylene glycol pentapropylene
glycol,
hexaethylene glycol hexapropylene glycol,
heptaethylene glycol dipropylene glycol,
triaosaethylene glycol dipropylene
glycol,

heptaethylene glycol tripropylene glycol,
heptaethylene glycol tetrapropylene
glycol,
heptaethylene glycol pentapropylene
glycol,
heptaethylene glycol hexapropylene
glycol,
heptaethylene glycol heptapropylene
glycol,

octaethylene glycol dipropylene glycol,
octaethylene glycol tripropylene glycol,
octaethylene glycol tetrapropylene
glycol,
octaethylene glycol pentapropylene
glycol,
octaethylene glycol hexapropylene glycol,
octaethylene glycol pentapropylene
glycol,
octaethylene glycol octapropylene glycol,
polyethylene glycol polypropylene glycol,

tripropylene glycol triethylene glycol
monomethyl ether,
tetrapropylene glycol diethylene glycol
monomethyl ether,
tetrapropylene glycol triethylene glycol

monomethyl ether,

tetrapropylene glycol tetraethylene

glycol monomethyl ether,

pentapropylene glycol diethylene glycol

monomethyl ether,

pentapropylene glycol triethylene glycol

monomethyl ether,

pentapropylene glycol tetraethylene

glycol monomethyl ether,

hexapropylene glycol diethylene glycol

monomethyl ether,

hexapropylene glycol triethylene glycol

monomethyl ether,

hexapropylene glycol tetraethylene

glycol monomethyl ether,

hexapropylene glycol pentaethylene

glycol monomethyl ether,

hexapropylene glycol hexaethylene glycol

monomethyl ether,

heptapropylene glycol diethylene glycol

monomethyl ether,

heptapropylene glycol triethylene glycol

monomethyl ether,

heptapropylene glycol tetraethylene

glycol monomethyl ether,

heptapropylene glycol pentaethylene

glycol monomethyl ether,

heptapropylene glycol hexaethylene

glycol monomethyl ether,

heptapropylene glycol heptaethylene

glycol monomethyl ether

octapropylene glycol diethylene glycol

monomethyl ether,

octapropylene glycol triethylene glycol
monomethyl ether,

octapropylene glycol tetraethylene
glycol monomethyl ether,

octapropylene glycol pentaethylene
glycol monomethyl ether,

octapropylene glycol hexaethylene glycol
monomethyl ether,

octapropylene glycol heptaethylene
glycol monomethyl ether

octapropylene glycol octaethylene glycol
monomethyl ether

polypropylene glycol polyethylene glycol
monomethyl ether

tripropylene glycol triethylene glycol
monomethyl ether,

tetrapropylene glycol triethylene glycol
monomethyl ether,

tripropylene glycol triethylene glycol
monomethyl ether,

octapropylene glycol diethylene glycol
monomethyl ether,

octaethylene glycol dipropylene glycol
monomethyl ether,

octaethylene glycol tripropylene glycol
monomethyl ether,

octaethylene glycol tetrapropylene
glycol monomethyl ether,

octaethylene glycol pentapropylene
glycol monomethyl ether,

octaethylene glycol hexapropylene glycol
monomethyl ether,

octaethylene glycol heptapropylene
glycol monomethyl ether,

octaethylene glycol octapropylene glycol
monomethyl ether,
polyethylene glycol polypropylene glycol
monomethyl ether.

A solvent or diluent may be ~~incorporated~~
~~ed~~ into the raw materials such as boric
acid, borate ~~ester~~ ^{alcohols} of lower ~~alcohol~~ and
polyoxyalkylene, or into borate esters
of glycol ether.

If ~~the~~ ^a solvent or diluent are employed,
they must not disturb the ~~esterification~~ ^{esterification}
-dehydration or ester-exchange reaction
and their boiling ~~point~~ ^{points should} be preferable ~~byproducts~~
^{below} the boiling point of the ~~byproducts~~
~~cts~~ or polyoxyalkylenes.

^{Examples} of ~~the~~ ^{solvents} or ~~diluent~~ ^{diluent} ~~are~~
ethers such as diethyl ether, dioxane,
tetrahydrofuran; aliphatic hydrocarbons ^{heptane}
such as hexane, acetic anhydride, ~~hepta-~~
~~ne~~, octane, nonane, decane, undecane;
aromatic hydrocarbons such as benzene, ^{cyclohexane}
toluene, xylene; ~~cycloalkane~~ ^{cycloalkanes} such as ~~cy-~~
~~clohexane~~, cyclohexene; non-proton polar
~~compound~~ ^{compounds} such as dimethyl formamide, ~~di-~~ ^{dimethyl}
~~methyl~~ sulfoxide, hexamethyl polyamide
phosphate, acetonitrile, N-methyl pyrro-
~~lidone~~; and their chlorine substituted
~~compound~~ ^{compounds} such as chloroform and carbon
tetrachloride.

A ~~catalyst~~ ^{catalyst} for the ~~esterification~~ ^{esterification}
dehydration or ester-exchange reaction
may be used.

If ~~the~~ ^a ~~catalysts~~ ^{catalyst} are necessary for ^{condensation}
promoting the reaction, following ~~conde-~~
~~nsation~~ catalysts are recommended.

^{Examples}
~~Example~~ of the catalysts are metallic

^{salts}
~~salt~~ of organic ^{acids} ~~acid~~ such as ferrous ~~se-~~
~~tanoate~~, ferrous naphthenate, cobaltous ^{stannum}
naphthenate, manganese octanoate, ~~stann-~~
~~um~~ octanoate, stannum naphthenate, lead
octanoate, lead naphthenate, organotin
^{compounds}
~~compound~~ such as dibuthy tin diacetate,
dibuthyl tin dioctanoate, dibutyl tin
dilaurate, dibutyl tin dioleate, dibutyl
tin dimethoxide, oxidized dibutyl tin;
^{alcohols}
metal ~~alcoholate~~ such as tetrabutyl
titanate, tetrabutyl zirconate; titanium
^{chelates}
~~chelat~~ such as di-isopropoxy bis-acetyl
acetate titanium, 1, 3-propanedioxy 3-propanedioxy
bis-ethylacetate titanium, 1, 3-propa-
nedioxy bis-ethylacetoacetate titanium;
^{aluminum} ^{chelates}
~~aluminum~~ ~~chelate~~ such as ^{aluminum} ^{acetyl-}
~~acetate~~, ^{aluminum} ~~aluminum~~ tris-ethylacetoaceto-
nate; amines such as hexyl amine, ^{dodecylamine}
~~ylamine~~ phosphate, dimethyl hydroxyamine,
diethyl hydroxyamine; tetra-ammonium ^{inorganic}
^{salts}
~~salt~~ such as benzyl hydroxyamine; ~~inorg-~~
^{acids}
~~anic acid~~ such as hydrochloric acid,
nitric acid, sulfuric acid, phosphoric ^{anhydride}
~~acid~~; ^{organic acids}
~~organic acid~~ such as acetic ~~anhyd-~~
~~ride~~, pure acetic acid (over 99.8%), ^{propionic}
~~pionic~~ acid, citric acid, benzoic acid,
formic acid, acetic acid, oxalic acid,
p-toluenesulfonic acid; ^{chlorosilanes}
~~chlorosilane~~ ^{dimethyl}
such as methyl tri-chlorosilane, ~~dimeth-~~
~~yl~~ di-chlorosilane; ^{bases}
inorganic ~~base~~ such
as aqueous ammonia; ^{bases}
organic ~~base~~ such as
ethylene diamine, tri-ethanol amine; and
amino alkylamine.

It is preferable that the ~~esterification~~
~~ion-dehydration~~ or ester-exchange ~~reac-~~ reaction
~~tion~~ is carried out under the ~~condition~~
^{esterification-dehydration}
^{conditions}

of ~~at~~ reduced or atmospheric pressure, ^{and preferably} from 50 to 250°C temperature, ~~favourably~~ from 100 to 180°C.

~~Under~~ ^{During} the reaction, removal of ~~byprod-~~ ^{byproducts} ucts such as lower ~~alcohol~~ ^{alcohols} or water can proceed the reaction easily because ~~rem-~~ ^{removal} oval of byproducts ~~proceed~~ ^{proceeds} the reaction equilibrium to ~~favorable~~ ^{favor} direction of ~~formation~~ ^{formation} borate ester ~~of polyoxyalkylenes format-~~ ^{of polyoxyalkylene} ion.

As to the removal method, azeotropic distillation using azeotropic agent and batch or continuous distillation using distillation tower are preferable.

For the purpose of improving the ~~prop-~~ ^{properties} erties of the borate ester of ~~polyoxal-~~ ^{polyoxyalkylenes} kylene, amino-group containing ~~compound~~ ^{compounds} and/or ~~solvent~~ ^{solvents} may be added to ~~said~~ ^{the} borate esters of polyoxyalkylenes.

Adding the amino-group containing ~~com-~~ ^{compound} pound to the borate ~~ester~~ ^{esters} of ~~polyoxal-~~ ^{polyoxyalkylenes} kylene ~~exhibits the suppressing~~ ^{causes suppression} of borate ester hydrolysis and also ~~exhibits~~ ^a rust preventive effect under the ~~condit-~~ ^{condition} ion of existense of water or its vapor.

Examples of the amino-group containing compound include alkylamine, cyclo alkyl amine, alkanol amine, heterocyclic amine, diamine, lactam, cyclic imide and ~~poly-~~ ^{polyamine} amine, which may be used alone or ~~combi-~~ ^{combination} nation ~~selecting from these compound.~~

As the alkyl amine, there can be used methyl amine, dimethyl amine, trimethyl amine, ethyl amine, diethyl amine, ~~tri-~~ ^{triethyl} ethyl amine, propyl amine, N, N-di[poly(4) oxyethyl] hexadecyl amine, dodecyl ~~dime-~~ ^{dimethyl}

~~thyl~~ amine, stearamide propyl dimethyl amine, polyoxyethylene (3-30) octadecyl amine, polyoxyethylene (3-30) lauryl amine, polyoxyethylene (3-30) oleyl amine, ^{polyoxyethylene} ~~polyoxyethylene~~ (3-30) dilauryl amine, ^{polyoxyethylene} ~~polyoxyethylene~~ (3-30) stearyl amine, ^{polyoxyethylene} ~~polyoxyethylene~~ (3-30) alkylamine, polyoxyethylene (3-30) dialkyl amine, and di (oleoyloxyethyl) hydroxy amine.

As the cycloalkyl amine, there can be used cyclohexyl amine, methyl cyclohexyl amine and ethyl cyclohexyl amine.

As the alkanol amine, there can be used ethanol amine, diethyl hydroxy methyl amine, diethanol amine, dimethyl ^{aminoethanol} ~~amino~~ ethanol, triethanol amine, propanolamine, dimethyl 2-hydroxypropyl amine, butanol amine, methyldi (2-hydroxyethyl) amine, tri (2-hydroxyethyl) amine, hydroxymethyl di (2-hydroxyethyl) amine, dibenzyl ^{2-hydroxypropyl} ~~2-hydroxyethyl~~ amine and cyclohexyl di (2-hydroxyethyl) amine.

As the cycloalkanol amine, there can be used cyclohexanol amine, ^{methylcyclohexanol} ~~methylcyclohexanol~~ amine and ethylcyclohexanol amine.

As the heterocyclic amine, there can be used pyridine, lutidine, 3, 4-xylidine, piperidine, N-methyl piperidine and N-ethyl piperidine.

As the lactam, there can be used proiolactam, N-methylpropylolactam, N-ethyl ^{butyrolactam} ~~butyrolactam~~, N-methyl valerolactam, N-methyl caprolactam and phenyl ^{caprolactam} ~~caprolactam~~.

As the cyclic imide, there can be used

succinimide, N-methyl succinimide, N-ethyl succinimide, phenyl succinimide and 2-undecyl imidazoline.

As the diamine, there can be used ethylene diamine, triethylene diamine and tetraethylene diamine.

As the polyamine, there can be used diethylene triamine, triethylene tetra~~mine~~^{tetra mine} and pentaethylene pentamine.

Among these ~~aminogroup~~^{amino-group} containing ~~com-~~^{compounds,} ~~pound,~~ tertiary ~~aminogroup~~^{amino-group} containing compounds exhibit excellent ~~effect~~^{effects} of preventing hydrolysis of borate ester of polyoxyalkylene and promoting the cleaning and purging the coloured ~~contaminants~~^{contaminates}.

Examples
Example of tertiary ~~aminogroup~~^{amino-group} containing ~~ng~~ compounds having above mentioned excellent properties are polyoxyethylene (3-30) octadecyl amine, polyoxyethylene (3-30) laurylamine, polyoxyethylene (3-30) oleyl amine, polyox-yethylene (3-30) ~~dilauryl~~^{dilauryl} amine, polyoxyet-hylene (3-30) stearyl amine, polyoxyethyl-ene (3-30) alkylamine, polyoxyethylene (3-30) dialkyl amine and di (oleoyloxyethyl) hydroxy amine.

The amount of ~~aminogroup~~^{amino group} containing ~~borate~~^{borate} compound to 100 parts by weight of ~~borate~~^{borate} ester of polyoxyalkylene is from 0 to 100 parts by weight; ~~favourably~~^{and preferably} from 5 to 50 parts by weight and most ~~favourably~~^{preferably} from 10 to 30 parts by weight.

Use of the solvent contributes to lower viscosity of the borate ester of polyoxyalkylene, X

As the solvent, there can be used

water, methyl alcohol, ethyl alcohol, isopropyl alcohol, butyl alcohol, ^{isopropyl} ~~isopropyl~~ ether, ether, ethylene glycol, ^{polyethylene} ~~poly-~~ ~~ethylene~~ glycol, polyethylene dimethyl ester, diethylene glycol, triethylene glycol, ethylene glycol dimethyl ether, ^{diethylene} ~~diethy-~~ ~~lene~~ glycol diethyl ether, ethylene glycol ^{glycol} ~~col~~ dipropyl ether, triethylene glycol dimethyl ether, triethylene glycol ~~mono-~~ ^{monobutyl} ~~butyl~~ ether, diethylene glycol ~~monobutyl~~ ^{monobutyl} ether, diethylene glycol diethyl ether, diethylene glycol propyl ether, ^{dimethyl} ~~dime-~~ ~~thyl~~ ether, propylene glycol, acetone, methylethyl ketone, furfural, dioxane, methane sulfonate, diethyl ether, tetrahydrofuran, hexane, acetic anhydride, ^{undecane} ~~undeca-~~ ~~ne~~, benzene, toluene, xylene, ^{cyclohexane} ~~cyclohex-~~ ~~ane~~, cyclohexene, dimethyl formamide, dimethyl sulfoxide, hexamethyl triamide ^{pyrrolidone} ~~pyrro-~~ ~~lidone~~, phosphate, acetonitrile, N-methyl pyrrolidone, chloroform and carbon tetrachloride ^{tetrachloride} ~~tetrachlo-~~ ~~ride~~ and ^{these} ~~the~~ solvents ^{can be} ~~are~~ used ~~by~~ alone or ⁱⁿ ~~a~~ combination.

The amount of solvent to 100 parts by total weight of borate ester of ^{polyoxyalkylene} ~~polyoxy-~~ ~~alkylene~~ and ^{amino-group} ~~aminogroup~~ containing compounds ^{are} ~~are~~ from 0 to 100 parts by weight, ^{and preferably} ~~favourably~~ from 5 to 50 parts by weight and most ~~favourably~~ from 10 to 30 parts by weight.

^{Ingredients} ~~The other ingredient~~ other than ^{amino-} ~~amino-~~ group containing ^{compounds} ~~compound~~ and/or ^{solvents} ~~solvent~~ may be incorporated to borate ~~ester~~ of ^{esters} ~~esters~~.

polyoxyalkylenes improving
~~polyoxyalkylene~~ for the purpose of ~~impr~~
~~oving~~ the properties of cleaning and
purging ^{the} resin compound of the present
invention.

other-ingredient
~~As the other ingredient,~~ there can be
used ^{such as} stabilizers, neutralizers, ^{antioxidant} ~~antioxi~~
~~nt~~, ultraviolet absorber, ^{stabilizers} ~~light~~ ^{processability} ~~stability~~
~~zer~~, antistatic agent, lubricant, ^{dispersing} ~~ssability~~ improving agent, filler, ^{anti-copper} ~~ersing~~ agent,
coupling agent, anticopper
rusting agent, blowing agent, nuclear
forming agent, ^{anti-foaming} ~~anti-forming~~ agent, ^{deformers} ~~deform~~
~~ers~~, ^{colorants} ~~colourant~~, pigment, dyeing agent,
carbon black, water tree preventing
agent, voltage stabilizer, ^{anti-tracking} ~~antitracking~~
agent, organic peroxide, crosslinking
agent, disinfectant, antiseptics, ^{anti-mold} ~~anti~~
~~mold~~ agent and ^{anti-rust} ~~antirust~~ agent.

The antistatic agent of the present
invention is a chemical compound having
the function to prevent following
problems.

One problem is that the dusts in ^{area surrounding} ~~surr~~
~~ounding near~~ the plastic resin formed
product are adsorbed on ^{the formed products} ~~that~~, resulting
not only to ^{making} ~~make~~ their appearance worse
but also to ^{creating an} ~~give~~ uncomfortable feeling
when ^{workers} ~~worker~~ or ^{users} ~~user~~ touches ^{the formed products} ~~that~~.

The other problem is electrical ^{charging} ~~charg~~
~~ing to cause~~ ^{which causes} of ignition or production
~~stopping~~, which is caused by ^{when} ~~that~~ the
plastic resin formed ^{products} ~~product~~ ^{contact} ~~surrounds~~
~~to the~~ parts of a processing machine at
the production step.

Another problem ^{effects} ~~is giving bad influen~~
~~ce~~ at surface treating of the plastic ^{influence}

products and causes problems associated with

~~product~~ such as printing, painting or corona discharging.

The antistatic agent of the present invention is prepared using one or more than ~~one~~ kind of borate ~~ester~~ ^{esters} of polyox-
alkylene. polyoxyalkylenes

The antistatic agent may contain ~~amino~~ ^{amino-group} group containing ~~compound~~ ^{compounds} and/or ~~solvent~~ ^{solvents}. contain

The antistatic agent may further contain ~~an~~ surface active agent, ^S pigment, ^S dye, ^S inorganic filler, ^S dripping ~~preventable~~ ^{prevent} agent, ^S precipitation ~~preventable~~ ^{prevent} agent, ^S antioxidants and deformer ^S.

The antistatic agent may be filled in ~~the~~ ^{an} aerosol container with ^a propellant.

Coating of the antistatic agent of the present invention on the surface of ~~the~~ plastic molded product, ^S plastic film, ^S machines machine part, ^S apparatus or process machine can be conducted by brushing, ~~spray~~ ^{spraying} ing, dipping of the antistatic agent, ^S or contacting ^a woven cloth or ^a nonwoven cloth which are immersed ⁱⁿ ^a the antistatic agent ~~onto~~ ^{to} the surface of the ~~plastic~~ ^{antistatic} molded product, ^S plastic film, ^S machine machine part, ^S apparatus and process machines.

The antistatic agent of the present invention can be heat kneaded into ^a ~~plastic~~ ^{plastic} resin to form ^{an} antistatic plastic resin composition.

The antistatic plastic resin ~~composition~~ ^{composition} can be formed by ^a plastic processing machine to obtain ^a plastic film, sheet, bottle ~~and~~ ^{or} container having antistatic ~~property~~ ^{properties}.

The plastic resin used for the plastic

resin composition of present invention is ~~the~~^a thermoplastic resin.

As the thermoplastic resin, there can be used high density polyethylene, high pressure low density polyethylene such as HP-LDPE, EVA, EEA, Ionomer, olefin vinyl alcohol copolymer, LLDPE, VLDPE, polypropylene (PP), polystyrene (PS), ~~copolymer~~ acrylonitrile-butadiene-styrene ~~copolymer~~ (ABS), acrylonitrile-styrene copolymer (AS), acrylonitrile-butadiene copolymer, acrylonitrile acrylate-styrene copolymer, polyvinyl chloride (PVC), polyamide, ~~poly~~^{polymethyl methacrylate} ~~methacrylate~~ (PMMA), polyacetal (POM), aminopolyacrylamide, polyarylate, fluoro carbon resin, polyimide (PI), ~~polyamino~~^{polyaminobismaleimide} ~~bismaleimide~~ (PABI), polyamideimide (PAI), polyetherimide (PEI), bismaleimidetriazine resin (BT), polysulfone, polybutylene terephthalate (PBT), polyethylene terephthalate (PET), polyvinylidene chloride, polycarbonate (PC), polyvinyl acetate, polyvinyl alcohol, polyvinyl ether, ~~modified~~ polyvinyl formale, modified PPE, ~~modified~~ polyphenyleneoxide (PPO), polyphenylene sulfide (PPS), polyethersulfone (PESF), ~~polyarylsulfone~~ polyetheretherketone (PEEK), ~~polyarylsulfone~~ (PAS), polymethylpenten (TPX), liquid crystal polymer, silicone resin, natural rubber (NR), butyl rubber (IIR), ~~acrylonitrile~~^{acrylonitrile} butadiene rubber (NBR), chloroprene rubber (CR), styrene butadiene rubber (SBR), butadiene rubber (BR) and the like.

Production ~~method~~ of the antistatic ~~specific~~^{specific} resin composition is not limited to ~~specific~~^{specific} method; however, following method

is desirable.

To the 100 parts by weight of a ~~thermo~~^{thermoplastic} plastic resin, 0.1~10 parts by weight of a borate ester of glycol ether expressed by general formula (1) is added.

The form of the thermoplastic resin may be ^a powder or pellet form.

The borate ester of polyoxyalkylenes may be soaked into ^{the} thermoplastic resin powder or pellet.

~~The soaking~~^{It} is desirable to conduct ^{the soaking} at ^{greater than} the temperature of ~~over~~ the glass trans-^{transition} ition point ~~because at the temperature~~ ~~soaking speed is fast~~ ^{to speed up the soaking}

The other production method for the antistatic resin composition of the ~~pre-~~^{present} sent invention may be conducted as follows.

The thermoplastic resin and borate ester of polyoxyalkylenes are fed to plastic processing machine or bunbury mixer, in which they are blended and extruded ~~from~~^{through} pelletizing die ~~having~~^{having} many holes of 3~7mm diameter.

Each ^{of the} extruded strings are cut to form ~~pellet~~^{pellets} having ~~the~~^a length of 3~7mm.

In case the amount of the borate ester of polyoxyalkylenes is less than 0.1 parts by weight, the resin composition for purging does not exhibit the ~~clean-~~^{cleaning} ing and perging effect and ^{having the amount of borate ester} ~~in case~~ more than 10 % parts by weight ~~it~~^{is} is not desirable because ~~the~~^{of} uniform polymer blend is barely obtained. ^{of polyoxyalkylenes}

EXAMPLE

Now, an antistatic agent ~~characterized by~~ containing a borate ester of ~~polyoxyalkylene~~ ^{polyoxyalkylene} and an antistatic plastic resin composition, and an antistatic plastic resin formed product according to the present invention will be described in further detail with reference to ~~Example~~ ^{specific examples}.

However, it should be understood that the present invention is by no means restricted by such specific ~~Example~~ ^{examples}.

Example 1

Borate ester of polyoxyalkylenes ~~expressed~~ ^{expressed} by chemical formula (12) was ~~obtained~~ ^{obtained} by ~~the~~ following synthesis process.

In a 7000 ml flask equipped with three inlet ~~pipe~~ ^{pipes} and displaced by nitrogen gas were charged 146g (1 mole) of triethyl borate $[B(OC_2H_5)_3]$, 1.2g of dibutyl tin dilaurate and 50 ml of benzene.

Subsequently, ^{to} the solution in the flask was added with 1796g (2 mole) of eicosaethylenglycol and 912g (1mole) of eicosaethylenglycol monomethyl ether ^{under} under stirring ~~conditions~~ ^{conditions} to obtain ^a ~~uni-~~ ^{uniform} blended solution.

Subsequently, the solution in the flask was stirred for 13 hours at 95°C under ~~the condition of~~ ^{conditions} distillation ^{to} to remove ~~a~~ ethanol and benzene as the ~~by-~~ ^{byproduct} ~~product~~ ^{and} to obtain 2716g (0.99 mole) of a borate ester of polyoxyalkylenes ~~expre-~~ ^{expressed}.

~~ssed~~ by chemical formula (12).

polyoxyalkylenes

Also, the other borate ester of ~~polyox-~~
~~yalkylenes~~ expressed by chemical formula
(23) was obtained by following synthesis
process.

In a 7000 ml flask equipped with three
inlet ~~pipe~~^{pipes} and displaced by nitrogen gas
were charged 2264g (2 mole) of pentacosa
ethylenglycol and 242g (1mole) of
pentadecanol under stirring ~~condition~~^{conditions} to
obtain^a uniform blended solution.

Subsequently, the solution in the
flask was stirred for 13 hours at 95°C
under ~~the condition~~^{conditions} of distillation^{to}
remove a ethanol and ~~benzene~~^{benzene} as the by~~pr-~~^{product}
~~oduct~~^{and} to obtain 2514g (0.99 mole) of a
borate ester of polyoxyalkylenes ~~expre-~~
~~ssed~~ by chemical formula (23).

Then, an antistatic agent (1) consisting
50 parts by weight of borate ester of
polyoxyalkylenes expressed by chemical
formula (12) and 50 parts by weight of ~~expressed~~
borate ester of polyoxyalkylenes ~~expre-~~
~~ssed~~ by chemical formula (23) and 15 parts
by weight of triethylamine was prepared
by mixing the above three components.

In a vessel, 100 parts by weight of a
high pressure low density polyethylene
(made by Nippon Unicar Company Ltd., melt
mass flow ~~late~~^{rate} 10.0g/10 min., density 0.92
3g/cm³) and 0.2 parts by weight of the
antistatic agent (1) obtained by^{the} above
mentioned method were blended for 5 ~~min-~~^{minutes}
~~utes~~ under room temperature to obtain a
mixture, ~~then the~~^{the} mixture was thrown ~~in-~~^{into}
~~to the~~^a continuous blending extruder (made

by K. C. K. Company Ltd., machine name K. C. K 80×2-35 VEX type) under ^{conditions} ~~condition~~ of ^a ~~cyl~~ cylinder ~~under~~ temperature of 190 °C to ~~produce~~ ^{into pellets} ~~form~~ the resin composition as ~~a pellet form~~ having length of 3mm and diameter of 3mm.

The resin composition was named ~~hereaf-~~ ^{hereafter} ~~ter~~ antistatic resin composition (1).

Then ^a tubular film having ^{a thickness of} 50 μ m ~~thickne-~~ ^{thickness} ~~ss~~ was prepared using ^{the} antistatic resin composition (1) by ^{an} air cooling inflation film processing machine.

The tubular film was named ~~hereafter~~ ^{hereafter} antistatic tubular film (1).

Subsequently, the antistatic effect ^{following} evaluation test was conducted by ^{the} ~~the~~ ^A ~~following~~ ^{ing} procedures.

The tubular film (1) was left on ^a ~~the~~ temperature table under ~~the~~ condition of 23°C ~~tempera-~~ ^{temperature} ~~ture~~ and 50% RH (Relative Humidity) for three days, then the surface resistivity ~~for~~ the tubular film (1) was measured ^{Standard} according to Japanese Industrial ~~Standards~~ ^{Standard} K 6911 to find $7.21 \times 10^{11} \Omega$ resistivity for ^{the} outer surface and $1.28 \times 10^{12} \Omega$ resistivity for ^{the} inner surface, which are ~~excellent~~ ^{resistivity excellent} ~~value comparing~~ ^{values compared} to that of ~~comparative~~ ^{comparative} example 1 as shown below.

The half-life of electrostatic voltage for the tubular film (1) was measured ^{Standard} according to Japanese Industrial ~~Standards~~ ^{Standard} L1094 to find 1.43 sec. for ^{the} outer surface of the film and 1.92 sec. for ^{the} inner surface of the film, which are ~~excellent value comparing~~ ^{values compared} to that of comparative example 1 as shown below.

When 30 days had passed from the day

electrostatic

that resistivity and half-life of ~~electrostatic~~ voltage were measured, the same tests were conducted to find $9.75 \times 10^{11} \Omega$ resistivity for outer surface and $4.08 \times 10^{12} \Omega$ resistivity for inner surface, which were excellent ~~value comparing~~ ^{Values compared} to comparative example and to find 2.51 sec. half-life of electrostatic voltage for outer surface and 3.11 sec. half-life of electrostatic voltage for inner surface, which was excellent ~~value comparing~~ ^{Values compared} to that of comparative example 1 as shown below.

Comparative example 1

As an example of conventional type antistatic agent (2), 2 mol^{of} ethyleneoxide added stearylamine was prepared.

In a vessel, 100 parts by weight of a high pressure low density polyethylene (made by Nippon Unicar Company Ltd., melt mass flow ~~rate~~ ^{rate} 10.0g/10 min., density 0.923g/cm³) and 0.2 parts by weight of a conventional type antistatic agent (2) were blended for 5 minutes under room temperature to obtain ^a mixture, then the mixture was thrown into ^a the continuous blending extruder (made by K. C. K. Company Ltd., machine name K. C. K 80×2-35 VEX type) under conditions of ^a cylinder temperature of 190 °C to ~~produce~~ ^{form} the resin composition ^{composition} ~~ion as~~ ^{into} a pellet ~~form~~ having ^a length of 3mm and ^a diameter of 3mm.

hereafter

The resin composition was named ~~hereaf-~~ ^{ter} antistatic resin composition (2).

a a thickness of ~~thickness~~
Then tubular film having $50 \mu\text{m}$ thickne~~ss~~
ss was prepared using antistatic resin
composition (2) ~~by~~ ^{and an} air cooling inflation
film processing machine.

The tubular film was named hereafter
antistatic tubular film (2).

Subsequently, the antistatic effect following
evaluation test was conducted by follow~~ing~~
ing procedures.

The tubular film (2) was left on the ~~the~~ ^a temperature
table under the condition of 23°C tempera~~ture~~
ture and 50% RH (Relative Humidity) for
three days. ~~then~~ ^{then} the surface resistivity
for the tubular film (2) was measured ^{Standard}
according to Japanese Industrial ~~Standar~~
rd K 6911 to find $8.65 \times 10^{11} \Omega$ resistivity
for ^{the} outer surface and $2.45 \times 10^{12} \Omega$ resisti^{resistivity}
vity for ^{the} inner surface, which ~~was~~ ^{are} ~~inferi~~ ^{interior}
or ~~value comparing~~ ^{values compared} to that of example 1
as shown above.

The half-life of electrostatic voltage
for the tubular film (2) was measured ^{Standard}
according to Japanese Industrial ~~Standar~~
rd L 1094 to find 9.45 sec. for ^{the} outer
surface and 10.87 sec. for ^{the} inner surface,
which ~~was~~ ^{are} ~~inferior~~ ^{values compared} ~~value comparing~~ to
that of example 1 as shown above.

Example 2

Borate ester of polyoxyalkylenes ~~exp~~ ^{expressed}
essed by chemical formula (8) was obtain^{obtained}
ed by ^{the} following ^a synthesis process.

In a 7000 ml flask equipped with three
inlet ~~pipe~~ ^{pipes} and displaced by nitrogen gas
were charged 146g (1 mole) of triethyl

borate $[B(OC_2H_5)_3]$, 1.2g of dibutyl tin dilaurate and 50 ml of benzene.

Subsequently, ^{to} the solution in the flask was added with 756g (3 mole) of pentylethylenglycol monomethyl ether ^{uniform} under stirring condition to obtain ~~uni-~~ ~~form~~ blended solution.

Subsequently, ^{to} the solution in the flask was stirred for 13 hours at $95^\circ C$ under ~~the condition of~~ distillation ^{conditions} to ^{by product} remove ~~a~~ ethanol and benzene as the ~~by-~~ ~~product~~ ^{and} to obtain 758g (0.99 mole) of a borate ester of polyoxyalkylenes ~~expre-~~ ^{expressed} ~~ssed~~ by chemical formula (8).

Then, an antistatic agent (3) consisting 1 parts by weight of borate ester of polyoxyalkylenes expressed by chemical formula (8) and 1 parts by weight of polyoxyethylene (9) lauryl amine were prepared by mixing the above two components.

In a vessel, 100 parts by weight of a high pressure low density polyethylene (made by Nippon Unicar Company Ltd., melt mass flow ^{rate} ~~late~~ 10.0g/10 min., density $0.923g/cm^3$) and 0.2 parts by weight of the antistatic agent (3) obtained by above mentioned method were blended for 5 ~~min-~~ ^{minutes} ~~utes~~ under room temperature to obtain mixture, ~~then the~~ ^{the} mixture was thrown ^{into} ~~in-~~ ~~to the~~ ^a continuous blending extruder (made by K. C. K. Company Ltd., machine name K. C. K 80X2-35 VEX type) under ~~conditions~~ ^{conditions} of a ^{ferm} cylinder temperature of $190^\circ C$ to ~~produce~~ the resin composition ~~as a pellet form~~ ^{into pellets} having ^a length of 3mm and ^a diameter of 3mm.

hereafter

The resin composition was named ~~hearafter~~
~~for~~ antistatic resin composition (3). ~~the thickness~~

Then ^atubular film having ^{a thickness of} 50 μm thickne~~ss~~
ss was prepared using antistatic resin
composition (3) ~~by~~ ^{and an} air cooling inflation
film processing machine.

The tubular film was named hereafter
antistatic tubular film (3).

Subsequently, the antistatic effect ^{following}
evaluation test was conducted by ~~the follow-~~
~~ing~~ procedures.

The tubular film (3) was left on ~~the~~ ^atemperature
table under the condition of 23°C tempera-
ture and 50% RH (Relative Humidity) for
three days. ~~Then~~ ^{the} the surface resistivity
for the tubular film (3) was measured ^{Standard}
according to Japanese Industrial Stand-
ard K 6911 to find $5.78 \times 10^{11} \Omega$ resistivity
for ^{the} outer surface and $0.97 \times 10^{12} \Omega$ resisti-
vity for ^{the} inner surface, which were excel-
lent value ~~comparing~~ ^{values compared} to that of example
1. ^{excellently}

The half-life of electrostatic voltage
for the tubular film (3) ~~was~~ ^{was} measured ^{Standard}
according to Japanese Industrial Stand-
ard L 1094 to find 1.18 sec. for ^{the} outer
surface and 1.76 sec. for ^{the} inner surface,
which ~~were~~ ^{are} excellent value ~~comparing~~ ^{values compared} to
that of example 1.

When 30 days had passed from the day ^{electrostatic}
that resistivity and half-life of elect-
rostatic voltage were measured, the same
~~test~~ ^{tests} were conducted to find $7.67 \times 10^{11} \Omega$
resistivity for ^{the} outer surface and
 $3.89 \times 10^{12} \Omega$ resistivity for ^{the} inner surface,
which ~~were~~ ^{are} excellent value ~~comparing~~ ^{values compared} to

example 1 and to find 2.12 sec. half-life of electrostatic voltage for ~~the~~ outer ~~surf-~~ surface and 2.69 sec. half-life of electrostatic voltage for ~~the~~ inner surface, which ~~were~~ ^{are} excellent ~~value comparing~~ to that of example 1. ^{Values compared}

^{experimental results show} The ~~experimental result~~ showed that the antistatic agent of the present invention had excellent ~~property~~ ^{properties and} that its ~~surf-~~ surface resistivity was ^a low value and its half-life of electrostatic voltage was ^a short time.

Low surface resistivity of the plastic film means that the plastic film will hardly be charged with static ~~electricity~~ ^{electricity} ~~ty, resulting~~ ^{so} that the plastic film will not adsorb the dust in ~~the surroundings~~ ^{surrounding areas}. ^{Voltage}

Short half-life of electrostatic ~~voltage~~ means that the durable term of the antistatic effect of the plastic film is long.

Also, the surface of the plastic film made by the resin compound of the present invention does not ~~show~~ sticky touch feeling. ^{provide a}